

IV. *On the classification of the Adephaga, or carnivorous series of Coleoptera.* By D. SHARP.

[Read February 1st, 1882.]

It is now more than twenty years since Leconte, writing on the classification of the *Carabidæ* (Class. Col. N. Amer., p. 5), said:—"Numerous efforts have been made to indicate a rational distribution of the genera, and the attempts commenced by Latreille and Bonelli, and successively improved by the suggestions of Dejean, Erichson, Schiödte, Lacordaire, and myself, have finally, in the expert hands of Schaum, assumed a form in which probably permanent results have been attained."

The learned and energetic American expert had himself contributed greatly—probably as much or more than any other of the talented entomologists he mentions—to the rational system of classification he describes, and had no doubt done so at the expense of great labour and time, and it was but natural that he should speak with confidence of results so legitimately obtained; but the lapse of time has not altogether justified his expression of reliance as to the permanency of the results then reached.

Duval, Chaudoir, C. J. Thomson, and other naturalists have worked since Leconte at the classification of these insects, and each has contributed more or less to knowledge, and has thus induced change. The genera of a large number of groups have been entirely remodelled by Chaudoir, whose recent decease has deprived us of one of the most indefatigable and useful of entomologists; while of the larger groups it may be truly said that at present but little accord exists as to their limits and arrangement, except in the case of certain comparatively small and isolated groups. And in point of fact we have learned that the natural classification of insects is a prodigiously complex and difficult affair; and at the same time the introduction of the theory of evolution has added much to the importance of the subject, and has helped to make it appear worthy of renewed efforts,

it being clear that our systems of classification will ultimately be appealed to as one of the modes of testing the *à priori* probability of organic evolution. Hence it is no matter for surprise that the subject is still of interest, and that it has recently received a fresh consideration from Dr. George Horn, who has already proved himself a worthy assistant of Leconte and his predecessors. In the Transactions of the American Entomological Society for July 1881, Dr. Horn has given us a paper extending to one hundred pages, illustrated by eight useful plates, wherein he has proposed a system of forty-eight tribes for the *Carabidæ*, and has prefaced his paper with a proposal for a modified arrangement of the carnivorous families of Coleoptera. This latter question is of course a still larger and more difficult one than that of the arrangement of the members of the *Carabidæ*, and I should not feel justified in expressing my opinion on it, except that I have recently required to devote some attention to the subject in connection with my work on the *Dytiscidæ*—one of the carnivorous families—now in course of publication by the Royal Dublin Society.

In his treatment of the *Carabidæ* Dr. Horn has made a decided improvement by adopting three subfamilies, viz., *Carabinae*, *Harpalinae*, and *Pseudomorphinae*, instead of two, viz., *Carabinae* and *Harpalinae*, as has been heretofore done. These subfamilies are limited primarily by the structure of the middle coxal cavities, a character that is found by experience to be of primary importance in the carnivorous series, and is indeed of very great importance and assistance throughout the whole order of beetles. About a year and a half ago I published a preliminary notice on the classification of the *Dytiscidæ* (*Comptes-rendus Soc. Ent. Belg.*, xxiii. p. cli), and pointed out that one of the two series of this family differed from the other series, and, so far as was then known, from all *Carabidæ* and other Coleoptera, by the fact that the metathoracic episternum, as well as three other pieces of the sternum, entered into the composition of the articular cavities of the middle legs. Dr. Horn has now made the interesting discovery that in a single genus of the *Carabidæ* a similar structure prevails: that genus is *Mormolyce*. Now *Mormolyce* has been known for a number of years as one of the wonders of the insect world, and so extraordinary is it in appearance,

and so totally different in this respect from any other Carabid, that it stands unique to the eye; and when to this extraordinary facies is added the important fact that it departs from all other *Carabidæ* by the primary point of structure already mentioned, and agrees therein with the *Dytisci complicati*, to which, however, it has no other point of resemblance, it is evident that we have in *Mormolyce* an extremely isolated organism. Dr. Horn (*op. cit.*, p. 150) points out the want of agreement that has prevailed as to its position even before his discovery of its extraordinary cotyloid peculiarity. Under these circumstances it appears to me very strange that the talented American has not had the courage of his convictions, or rather of his discovery, and isolated *Mormolyce* in his classification, as it is in nature. He has not, however, done so, but has adopted the illogical course of disregarding his own discovery, and placing *Mormolyce* in the *Harpalinæ*, although the one character by which *Harpalinæ* are distinguished from *Carabinæ* is that "the middle coxal cavities are entirely closed by the sterna, the epimeron not attaining the coxa," and although in *Mormolyce* the middle coxal cavities are not entirely closed by the sterna, and the epimeron (and meta-thoracic episternum also) does attain the coxa. To put it more briefly, the *Harpalinæ* are separated from the *Carabinæ* by a difference in the cotyloid structure; *Mormolyce* departs from the *Harpalinæ* in this respect a good deal more strongly than do the *Carabinæ*, and yet is classed with the *Harpalinæ*. This course appears to me a very erroneous one; indeed I fail to see how classification can ever be of scientific value while subject to such treatment. It is true that if *Mormolyce* were connected with the *Harpalinæ* by a series of intermediate forms, there might then be some reason for connecting it with them, in spite of the cotyloid structure; but, as is abundantly clear from Dr. Horn's careful study of its characters, this is not the case, and I think *Mormolyce* should therefore not be connected with the *Harpalinæ*.

I quite agree with Dr. Horn in his separation of the *Pseudomorphinæ* from the other members of the *Harpalinæ*; in this he has done well, for the group is a natural one in the sense that all its members are clearly allied together, while it is, I believe, perfectly distinct by well-marked characters, and by the absence of intermediate

forms. Some of the older entomologists appear to have supposed, indeed, that the insects forming this subfamily were more allied to the *Dytiscidæ* and *Gyrinidæ* than to the *Carabidæ*, but detailed investigation has not supported this view, and the only position that can be correctly assigned to the *Pseudomorphini* in the present state of our knowledge is that given them by Dr. Horn, and already previously indicated by Duval (Gen. Col., *Carabidæ*, p. 47). There is, however, a question with regard to the group that has not, so far as I am aware, been yet investigated, *viz.*, whether any approximation exists between the group and the *Paussidæ*; and I mention this as an interesting subject for inquiry.

The family *Carabidæ* is at present composed as follows:—

75 species = 5 genera = (? 2) tribes = <i>Pseudomorphinæ</i> .	}	<i>Carabidæ</i> .
8000 species = 500 genera = (? 31) tribes = <i>Harpalinæ</i> .		
1800 species = 100 genera = 15 tribes = <i>Carabinæ</i> .		
3 species = <i>Mormolyce</i> .		

It will, I hope, be understood that the above tabulation is merely an approximation to the actual numbers, but it will be found sufficiently near the mark to allow us to detect some interesting statistical facts. Thus the average number of species to a genus in each of the three subfamilies is very nearly the same, being respectively 15, 16, 18; on the other hand, the average number of genera in each tribe is extremely different, being respectively 2.5, 16, and 6.75. I shall here content myself with pointing this out, and refrain from entering on any speculations about it. As regards the number of tribes, or aggregates immediately subordinate in complexness to the subfamily, I must however remark that their number is quite uncertain, and will probably prove to be considerably greater than that given by Dr. Horn, and approximately adopted above, for Dr. Horn's studies have been made chiefly on the North American forms, and the vast mass of exotic forms unknown to him would probably cause a considerable increase in the number of these tribes. No doubt also much additional consideration as to the limits and affinities of those proposed by the American writer will be necessary before

they can be accepted. In the case of the *Siagonini*, for instance, Horn departs from the views of Chaudoir as to the mesosternal structure, and states that the middle coxal cavities are closed externally by the junction of the middle pieces of the meso- and meta-thoraces, and that Schiödte, Schaum, and Chaudoir have been deceived in their supposition that these pieces are separated by the interposition of the mesothoracic epimeron. To determine this he relies on macerating the specimen in caustic potash, but this appears to me a very unsafe proceeding,—and for this reason,—the mesosternum of *Siagona* is a very peculiar one, and the pieces forming it are all soldered together, but they are traversed by some prominent ridges, along which the chitinous substance is very much thicker than elsewhere, and these ridges may longer resist the action of the potash, and so give rise to a deceptive appearance of sutures; moreover, after having made a special dissection of the largest *Siagona* (*S. dejeani*) and removed the metathoracic episternum, it appears to me clear that the suture separating the middle piece of the mesosternum from the side piece can be undoubtedly traced, and that Chaudoir, Schaum, and Schiödte were correct in considering that the mesothoracic epimeron separates the middle sternal pieces. I think, therefore, we should be reluctant to accept the evidence of preparations that have passed through so serious an ordeal as that of maceration in caustic potash, in opposition to the direct evidence from unaltered specimens.

In the case of many of the tribes Dr. Horn adopts, he makes use of the same names for them as have been used by his predecessors, although giving to those names a widely different extension or meaning. This plan is that usually adopted by zoologists, but it is accompanied by the great disadvantage that it gives to classifications a false appearance of accord and permanence, and also, by giving to the names the sanction of long use, tends to make them appear in the eyes of many of more importance than they are in fact. Indeed, I myself am of opinion that classification of the groups superior far from approximation to the actual facts, and that these groups will thus probably in future assume a totally different form, that we should do well to refrain from giving them names at all, contenting ourselves with the simple

method of numbering the tribes, groups, &c., instead of naming them.

I had intended making a comparison of Dr. Horn's tribes with those used by C. J. Thomson and Duval, but this I find to be impossible owing to the fact that the tribes of these authors consist of European insects, while Horn's are made chiefly on the North American fauna; moreover, as I have already stated, the same names do duty for very different values; thus these two facts render any positive comparison almost impossible.

In considering the families composing the carnivorous series, Dr. Horn adopts no less than seven families, *Cicindelidæ*, *Carabidæ*, *Haliplidæ*, *Amphizoidæ*, *Pelobiidæ*, *Dytiscidæ*, and *Gyrinidæ*. The first reflection about these families which occurs to one acquainted with the subject, is that they are of extremely different values; thus the word *Cicindelidæ* represents about 1000 species and forty genera; the word *Carabidæ* about 10,000 species of 600 genera; the word *Haliplidæ* about fifty species of three genera; *Amphizoidæ* two or three very closely allied species; *Pelobiidæ* two or three species; *Dytiscidæ* about 1200 species arranged in eighty genera; and *Gyrinidæ* 150 species of seven or eight genera. Here again Dr. Horn follows the system in vogue, and it is that system we must blame if we consider that this process of making single species appear the zoological equivalent of ten or twenty thousand species is an erroneous one. There is, however, an important fact indicated by this nomenclature, *viz.*, that certain species are as distinct in their structure from the great complex masses of species, as these latter are from one another; in this sense we see that the isolation as regards intermediate forms of a single species may be as great as that of ten thousand species from another ten thousand species. This is a fact of great importance, and it is clear that a method of nomenclature and classification that reveals instead of concealing these facts is a great improvement. A purely synthetical classification gives us these advantages; under it *Amphizoa insolens* would not be "a family," but would remain in classification an isolated creature until the synthesis of family value were reached. Putting aside, however, this technical objection, for which, as I have said already, Dr. Horn is in no sense exclusively responsible, we may

look, I think, upon Dr. Horn's families as natural ones. The distinction between the *Cicindelidæ* and *Carabidæ* long puzzled entomologists, and a few years ago the opinion of naturalists seemed to tend to uniting them as only one family, but the remarkable structure of the parts of the buccal cavity in the *Cicindelidæ* always left doubts as to the propriety of this course; and since Dr. Leconte pointed out that in addition to the mouth-differences there existed an important difference in the structure of the head, the general feeling has been to keep them as quite distinct aggregates. Dr. Leconte defined the difference between the two families in terms of the insertion of the antennæ, and this is repeated by Dr. Horn, who states that *Cicindelidæ* have "antennæ inserted on the front above the base of the mandibles," while the *Carabidæ* have "antennæ arising at the side of the head between the base of the mandibles and the eyes": this definition is not, however, a very good one, for there are certain *Carabidæ* which approximate much in this respect to the *Cicindelidæ* (cf. *Loricera*), and some, at any rate such as *Trichognathus*, that this definition would bring into the *Cicindelidæ*. Fortunately, however, it can be replaced by a formula that is, I believe, quite exact, and even more easily appreciated, viz., *Cicindelidæ*, "clypeus extending laterally in front of the insertion of the antennæ"; *Carabidæ*, "clypeus not extending so far towards the sides as the insertion of the antennæ."

As regards the separation of the *Haliplini* from the *Dytiscidæ*, and its treatment as a distinct aggregate, there is, I think, no reason to doubt this being a natural proceeding. So also as regards *Pelobius*; I have already expressed my opinion that it should not be left in the *Dytiscidæ*; and as it is not allied to any Carabid, Dr. Horn is probably justified in isolating it.

In discussing *Amphizoa* (Tr. Roy. Dub. Soc., n. s., vol. ii., p. 844), I expressed the opinion that it might be treated as an aberrant member of the *Dytiscidæ*, this view being largely derived from the fact that the *Dytiscidæ* were the only Coleoptera known to possess a structure of the middle coxal cavity similar to what exists in *Amphizoa*. This was, however, before Dr. Horn had benefitted us by his important discovery that *Mormolyce*—an undoubted member of the *Carabidæ*—likewise possesses this same structure. This introduces

quite a new, and a most important, factor into the treatment of this problem, and, seeing that *Amphizoa* agrees with certain *Carabidæ* as well as with most of the *Dytiscidæ* by the peculiarity I have alluded to, I think it will be a quite natural course to treat it as an aggregate (not as a family) occupying an intermediate position between *Carabidæ* and *Dytiscidæ*, but a member of neither.

The last family placed by Dr. Horn in the Adephagous or Carnivorous series is the *Gyrinidæ*, and at the end of his memoir (p. 187) he has placed a special short note, in which he states that "the structure of the external skeleton, as well as the mouth parts, seem to be so plainly adephagous as to leave no room for doubt." This rather positive affirmation is, however, scarcely justified by the definition and facts Dr. Horn gives us at the commencement of his essay, where he tells us (*op. cit.*, p. 91), "the adephagous series of Coleoptera is readily recognised by the predaceous character of its mouth parts, its slender antennæ (except in *Gyrinidæ*), pentamerous tarsi, and the structure of the first abdominal segment, which is in all cases divided or hidden by the posterior coxæ in such a manner that it is entirely lateral, rarely appearing as a small triangular piece between the posterior coxæ." Thus we are presented with four characters as justifying the introduction of an aggregate into the Carnivorous series, and a little consideration will show that by none of these characters is the place of the family *Gyrinidæ* indicated as being clearly in the series in question. 1st. As regards the mouth, it is well known that the trophi of *Gyrinidæ* depart very widely indeed from the *Carabidæ* and *Cicindelidæ*, the lower lip is of very much inferior development, and only to a slight extent of the predaceous type, and the maxillæ are either entirely destitute of the outer lobe, or when it is present, possess it undivided, and thus this family is very far indeed from agreeing with the other Carnivori in the mouth structure. 2nd. As regards the antennæ, nothing can well be more different from the setaceous or filiform adephagous antenna than is the highly peculiar antennal organ of the *Gyrinidæ*; but as Dr. Horn himself alludes to the fact that the *Gyrinidæ* are an exception in this respect, it is useless to deal more at length with this point. 3rd. The pentamerous tarsi: though the *Adephaga* possess generally (but not always,



vide *Hydroporides*) five-jointed tarsi, yet so also do a vast number of other Coleoptera not included in the *Adephaga*; and we cannot therefore take this into consideration, more especially when we recollect that the tarsi of *Gyrinidæ* are absolutely unique in their structure. 4th. The abdominal structure: in immediate sequence to the paragraph I have last quoted from Dr. Horn, there follows in his memoir another, in which he demonstrates that the ventral structure in *Gyrinidæ* is different from what prevails in the other families, and in point of fact it is undoubtedly the case that the *Gyrinidæ* have six ventral plates stretching quite across the under surface, and a seventh plate visible only on each side, while the true members of the adephagous series have five ventral plates extending all across the body, and a sixth visible only on each side. Thus in this character, as in all the others I have discussed, the *Gyrinidæ* depart from the other members of the adephagous series; and it is perfectly clear that the *Gyrinidæ* are not connected with any of the other components of the series by any characters of such immediate importance as connect these other components *inter se*. I think the *Gyrinidæ* will prove one of the most isolated of all the families of Coleoptera, and it is therefore not advisable to place them in a series, all of whose other components are linked together in the most intimate relations. I do not intend by this to deny that the *Gyrinidæ* may find their nearest allies in the *Adephaga*; that is quite another question from the above.

I must not pass from the consideration of Dr. Horn's paper without making some apology for the rather critical nature of my remarks, but this is scarcely necessary, for we all know that he is one of the most unprejudiced admirers of truth and accuracy, and I am convinced that he will no more be likely to find fault with me for discussing some of his conclusions than the lamented Chaudoir would have been to disagree with him because of his criticisms; but I cannot conclude without pointing out that, although we are still far from possessing a perfect classification of the carnivorous Coleoptera, yet Dr. Horn's paper shows that we are on the right road for getting one; and his contribution will undoubtedly prove to be a considerable assistance to those who, like himself, will have the courage and perseverance to aid research in this direction. Such a large amount of

original observation as is recorded in the definitions of the tribes and remarks on the subordinate groups and in the six plates closely filled with drawings of the trophi, cannot but be most useful to future systematists, and we may give our hearty thanks to Dr. Horn for the work he has accomplished.

Another paper on the classification of the Carnivorous Coleoptera has been recently published in the *Deutsche Ent. Zeit.* 24 (1880), pp. 258—280. It is by Herr Kolbe, and is entitled "Naturliches system der Carnivoren Coleoptera," and it is interesting to compare this with Dr. Horn's paper.

The author starts on the hypothesis that in distant geological periods water-beetles preceded land-beetles, that the land-beetles we now have are descended from water-beetles; and he consequently attaches great importance in his system to such points of structure as are common to water-beetles and certain land-beetles, such as a comparatively immobile prothorax and inferior development of the external sensitive structures of the antennæ. He starts with the "family Carnivora," which he defines, and which is synonymous with the "Adephagous series" of Horn, and is quite equivalent therewith, except that the German author has introduced into his family certain fossil insects which he treats as a sub-family, with the name *Escheriidae*. His definition of the family is of very little service practically, owing to nearly the whole of the characters mentioned being subject to exceptions. And the family is then divided into six sections—1, the *Ephydrodephaga*, the equivalent of *Gyrinidae* of other authors; 2, *Enhydrodephaga*, which equals the families *Dytiscidae*, *Pelobiidae*, and *Haliplidae* of Horn. Up to this point there is little or nothing novel in Herr Kolbe's system, but from this point to the end the arrangement is very different from any in vogue. The 3rd section is called *Amphidephaga*, and consists of the single genus *Omophron*. The 4th section comprises *Amphizoa*, *Trachypachys*, *Carabidae* (= *Notiophilini*, *Carabini*, *Cyehrini*), and *Pamboridae*, and is called *Heterodephaga*. Section 5, *Mesodephaga*, comprises the *Cicindelidae*, *Elaphridae*, *Metriidae*, *Loriceridae*, *Promecognathidae*, *Hiletidae*, *Scaritidae*, *Escheriidae* (fossil), *Siagonidae*, *Ozænidae*, and *Mormolycidae*. While the 6th and last section, called *Holodephaga*, consists of all the

enormous mass of *Carabidæ* (including the *Pseudomorphidæ*), except those groups that have been placed in one or other of the preceding sections.

Herr Kolbe supplements this formal sketch with some remarks on the various sections and some of the sub-families; some of his hints and suggestions will be found useful, but others are of a speculative rather than a practical character, and a future systematist who should pay much attention to these would be perhaps only confused.

To criticise at length this very original memoir would occupy me too long; it undoubtedly contains many suggestive comparisons, and indicates a considerable knowledge and much power of generalisation. But it is, as a natural system, completely erroneous, the author's hypothetical starting-point having caused him to attach undue importance to certain characters and to neglect others. Hence it is that he has reduced the *Cicindelidæ* to a mere subsection of his *Mesodephaga*, and has made a statement so illogical as that on p. 275, where he says that the peculiar insertion of the antennæ in the *Cicindelidæ* is merely a result of the enormous development of the mandibles; a conclusion which is contradicted by the fact that in the *Scaritidæ*, where the mandibular development is even greater than in the *Cicindelidæ*, the antennal insertion does not even approximate to that of the *Cicindelidæ*, but is more different therefrom than in the *Carabidæ*, with smaller mandibles; and by the fact that in *Trichognathus* and *Loricera*, where the antennal insertion approximates to that of the *Cicindelidæ*, the mandibles are unusually small.

Although we cannot look on Herr Kolbe's effort at a natural classification as successful, we nevertheless thank him for it; it is in fact very important that classification should be treated from various points of view, and every character receive its due share of attention, and thus any one who ventures far from the beaten track should be encouraged, for he is sure to bring to light something useful.